



Adhesive Capsulitis: Demographics and Predictive Factors for Success Following Steroid Injections and Surgical Intervention

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Purpose: Examine demographic factors of all patients treated for adhesive capsulitis by a single surgeon, report the treatments and outcomes of these patients, and determine the effectiveness of various treatments, including corticosteroid injections and operative intervention in relation to risk factors for adhesive capsulitis. **Methods:** All patients treated for adhesive capsulitis by a single surgeon between 2008 to 2014 with minimum 2 years' follow-up were identified via charts and operative reports and were eligible for inclusion. Demographic information including sex and medical comorbidities was documented. Preintervention and postintervention shoulder range of motion was recorded. Specific treatment information (number of corticosteroid injections, etc) was collected. Treatment outcomes were then compared as an aggregate and among varying comorbidities. **Results:** Overall, 1377 patients were treated for adhesive capsulitis (946 women vs 431 men [$P = .001$]). For patients with adhesive capsulitis: a higher percentage of men than women had diabetes (24.8% vs 17.3% [$P = .001$]); nondiabetic patients had better forward flexion at initial presentation than patients with diabetes (114° vs 108° [$P = .015$]); more patients with diabetes required capsular release than nondiabetic patients (13% vs 7.3% [$P = .003$]); more nondiabetic patients resolved adhesive capsulitis without corticosteroid or surgical intervention than patients with diabetes (83.6% vs 61.7% [$P = .001$]); more nondiabetic patients resolved adhesive capsulitis after single corticosteroid injection than did patients with diabetes (95.9% vs 86.7% [$P = .001$]). Multiple intraarticular corticosteroid injections provided no added benefit over a single injection in resolving adhesive capsulitis in patients with diabetes and nondiabetic patients. **Conclusion:** In shoulder adhesive capsulitis, women and patients with diabetes are more commonly affected, patients with diabetes respond less favorably to physical therapy in isolation and physical therapy plus corticosteroid injections than nondiabetic patients. No benefit from multiple intraarticular corticosteroid injections was seen compared with a single intraarticular corticosteroid injection in patients with diabetes and nondiabetic patients. Patients with diabetes and nondiabetic patients have functional improvement after capsular release and manipulation if conservative treatment for adhesive capsulitis fails. **Level of Evidence:** III, case control.

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Adhesive capsulitis of the shoulder is a painful, often idiopathic condition commonly seen by orthopaedic surgeons treating shoulder problems.¹ Although the cause of adhesive capsulitis is often unknown (excluding the onset after trauma or surgery), the pathology involves chronic inflammation of the subsynovial layer of the shoulder capsule, leading to loss of elasticity, thickening, fibrosis, and adherence of the capsule to the humeral neck.² Depending on the stage of the disease process at presentation, patients may present with pain, pain and loss of motion, or loss of motion with minimal pain (commonly at end ranges when the capsule is stretched past its level of compliance).³ Women in their 40s to 60s are most commonly affected by adhesive capsulitis, as are patients with diabetes and patients with thyroid issues (hypothyroid). Furthermore, adhesive capsulitis more commonly affects the nondominant than the dominant shoulder.^{4,5}

Once the diagnosis of adhesive capsulitis is correctly made (which can be difficult at times), initial treatment commonly involves a course of physical therapy (PT) focusing on gentle, progressive stretching with or without a glenohumeral corticosteroid injection.⁶ Supplemental treatments to physical therapy are numerous and include corticosteroid injections, antiinflammatory medications, hydrodilation, and capsular release with manipulation under anesthesia. Intraarticular corticosteroid injections have been shown to be effective in treating adhesive capsulitis, with improvements in pain and range of motion (ROM), whereas treatment with oral antiinflammatory medications has not generally produced effective results.^{7,8} Glenohumeral hydrodilation has shown mixed results and as such is typically not a routine part of the treatment algorithm for adhesive capsulitis.^{9,10} Because adhesive capsulitis often resolves without surgical intervention, a prolonged course of nonoperative management is offered in an attempt to avoid surgical intervention. Although many physicians offer corticosteroid injections because they have been shown to help with symptoms, there are limited data on the number of corticosteroid injections that should be provided during the course of conservative treatment to afford the maximum benefit to the patient. Furthermore, the ideal number of corticosteroid injections in patients with specific risk factors for adhesive capsulitis, such as diabetes, has not been determined. Once an extended course of nonoperative management has failed, surgical intervention in the form of arthroscopic capsular release with manipulation can be offered to patients.

The purpose of this study was to examine demographic factors of all patients treated for adhesive capsulitis by a single surgeon, report the treatments and outcomes of these patients, and determine the effectiveness of various treatments, including corticosteroid injections and operative intervention in relation to risk factors for adhesive capsulitis. The authors hypothesized that women and patients with diabetes would commonly be affected by adhesive capsulitis, multiple corticosteroid injections into the glenohumeral joint would be more effective than a single injection, and patients with diabetes would respond less favorably to corticosteroid injections than nondiabetic patients.

Methods

After institutional review board approval (IRB no. 12-14-34), a retrospective review was performed for all patients treated for idiopathic adhesive capsulitis by the senior author (R.G.), a shoulder and elbow fellowship-trained surgeon, between June 2008 and December 2014. Inclusion criteria were minimum age of 18, active and passive restriction of ROM of 20° or more in any plane compared with the contralateral shoulder, minimum follow-up of 2 years, and absence

of glenohumeral arthritis. Exclusion criteria were previous shoulder surgery, significant glenohumeral deformity from a prior injury, and a diagnosis of glenohumeral arthritis. Potential candidates for inclusion were identified by performing a chart review using ICD-9 code 726.0. Each chart was reviewed to confirm study eligibility on the basis of the study criteria.

Once patients were included, each chart was individually reviewed to collect demographic data including age, sex, race, presence or absence of diabetes, presence or absence of thyroid disorders, onset of symptoms (idiopathic or secondary), and previous surgery. The course of treatment was documented, noting PT (yes or no), the number of corticosteroid injections (none, one, or multiple), and any arthroscopic capsular release. ROM was assessed manually at each clinical visit by the senior author with the use of a goniometer with the patient in the supine position. Forward flexion was measured in the scapular plane, and external rotation was measured with the arm at the side.

Treatment

At the initial clinical visit, each patient was offered structured PT alone (focusing on gentle progressive stretching) or with the addition of a glenohumeral (GH) corticosteroid injection. Arthroscopic capsular release was not offered at the first appointment for any patient. A prescription for PT was given for three visits per week for 6 weeks, focusing on passive ROM that was then progressed to active assisted and active ROM. Caution of overstretching the GH joint and exacerbating the inflammatory response was detailed on all prescriptions. All GH injections were composed of 40 mg of triamcinolone acetonide (Kenalog; Bristol-Myers Squibb, Princeton, New Jersey) mixed with 6 mL of lidocaine and performed by the senior author using a posterior approach without image guidance. Repeat evaluations were performed at monthly intervals. At the subsequent visits patients were offered PT alone, PT with a repeat GH injection, or, if they had symptoms recalcitrant to treatment for a minimum of 6 months and stopped making gains in PT, an arthroscopic capsular release. A maximum of four GH injections were allowed. When conservative treatment failed, a 360° arthroscopic capsular release with manipulation was performed by the senior author. Symptom resolution was defined as return of full active and passive ROM of the affected shoulder compared with the contralateral shoulder, as well as good to excellent relief of pain as described by the patient.

Arthroscopic Capsular Release and Manipulation

The senior author performs the arthroscopic capsular release with the patient in the beach chair position similar to previously described techniques.¹¹ Briefly, a skin incision is made, and the arthroscope is introduced

into the glenohumeral joint via a posterior portal. Great care is taken to avoid chondral damage because there is often loss of tactile feedback from a stiff posterior capsule, and a greater amount of force is needed to introduce the trocar into the shoulder. A 360° capsular release is then performed with a combination of radiofrequency ablation, biter, elevator, and shaver. Once the capsule has been released circumferentially, the arthroscope is removed, and manipulation is performed. Excessive rotational torque on the humerus is avoided to mitigate the risk of fracture. PT is started the first day after surgery.

Statistical Analysis

Statistical analysis was conducted with SPSS 17.0 (SPSS, Chicago, Illinois). Descriptive continuous data were presented as the mean \pm standard deviation (SD). ROM were compared. A bivariate analysis was performed with a χ^2 test for categorical variables and Welch's *t* test for independent variables to determine differences between the two groups. Multivariate logistic regression was used to identify independent risk factors. Postoperative ROM was compared with preoperative ROM using Welch's *t*-test for independent variables.

Results

A total of 1377 patients (69% female) met the study criteria. Of these, 88% were white, 10% were black, and 2% were Asian or Latino. Furthermore, 20% had diabetes and 80% were nondiabetic. Mean active forward flexion was $113^\circ \pm 34^\circ$, and mean external rotation was $28^\circ \pm 14^\circ$ at initial presentation (Table 1). In patients with adhesive capsulitis, there was a higher prevalence of diabetes among men (24.8% [$P = .001$]) and a higher prevalence of hypothyroidism among women (13.4% [$P = .001$]). There was no difference in ROM between sexes at initial presentation (Table 2). There was no correlation between race and adhesive capsulitis ($P = .05$). Patients with hypothyroidism had no differences in demographics or response to treatment compared with patients without hypothyroidism. Patients with diabetes with adhesive capsulitis had less forward flexion 108° ($P = .015$) at initial presentation and were more likely to be treated with an arthroscopic capsular release (13%) than nondiabetic patients (7.3%; $P = .003$). However, there was no difference in

Table 1. Demographic Information for Patients Suffering From Adhesive Capsulitis

Risk Factor	Frozen Shoulder Cohort
Sex (female %)	69%
Age (mean, SD)	54.7 \pm 9.1
Diabetes (%)	20%
Hypothyroidism (%)	12%

SD, standard deviation.

Table 2. Pretreatment Age, Range of Motion and Endocrine Disorders by Sex in Patients With Adhesive Capsulitis

	Females (n = 946)	Males (n = 431)	<i>P</i> Value
Age (mean, SD)	54.3 \pm 9.2	55.5 \pm 8.9	.021
Baseline FF	112° \pm 32°	115° \pm 34°	.157
Baseline ER	29° \pm 15°	29° \pm 13°	.568
Diabetes	17.3%	24.8%	.001
Hypothyroidism	13.4%	5.6%	.001

ER, external rotation; FF, forward flexion; SD, standard deviation.

postoperative outcomes after capsular release between patients with diabetes and nondiabetic patients (Table 3).

Women without diabetes were more likely to have resolution with PT alone than men without diabetes (80.8% vs 68.9% [$P = .046$]). Similarly, women were more likely than men to resolve with a single glenohumeral injection ($P = .005$). Multiple glenohumeral corticosteroid injections provided no added benefit over a single corticosteroid injection regardless of sex or diabetic status (Table 4).

In patients with adhesive capsulitis, a single injection was more effective in resolving adhesive capsulitis than PT alone ($P = .001$). Two or more injections were no more effective than a single injection in resolving adhesive capsulitis. In the patients included in this study, 273 did not receive an injection, 934 received a single injection, and 175 received two or more injections. Only 61.7% of patients with diabetes had resolution with PT alone compared with 83.6% in the nondiabetic group ($P = .001$). Furthermore, fewer patients with diabetes resolved with a single injection compared with nondiabetic patients (Table 5).

Discussion

The author's hypotheses were partly confirmed because patients with diabetes were more likely to require a capsular release, but multiple corticosteroid injections were no more effective than a single corticosteroid injection at resolving symptoms from adhesive capsulitis. Adhesive capsulitis is a progressive condition caused by fibrosis and contracture of the glenohumeral joint capsule leading to pain and stiffness.¹² It is commonly described in four separate stages. Stage 1 involves shoulder pain, often seen at night, with no significant loss of shoulder motion, whereas stage 2 involves severe night pain with associated loss of shoulder motion.¹² Patients in stage 3 have profound loss of motion with some pain, but often less pain than those in stages 1 and 2, whereas those in stage 4 have significant stiffness but minimal pain.¹² First-line treatment commonly involves PT with or without an intraarticular corticosteroid injection. Surgical intervention is reserved for patients in whom conservative treatment has failed. Prior studies have shown

Table 3. Bivariate Analysis for Patients With Adhesive Capsulitis Comparing Diabetics and Nondiabetics

	Diabetics (n = 270)	Nondiabetics (n = 1107)	P Value
Baseline FF	108° ± 36°	114° ± 33°	.015
Baseline ER	28° ± 15°	29° ± 14°	.367
% Requiring capsular release	13.0%	7.3%	.003
Post-surgical outcomes			
° of FF improvement	30° ± 29°	39° ± 41°	.222
° of ER improvement	36° ± 12°	40° ± 16°	.301

ER, external rotation; FF, forward flexion.

efficacy in physical therapy, as well as corticosteroid injections in the treatment of adhesive capsulitis, although little data exist on the ideal number of corticosteroid injections.^{6,13}

One of the interesting demographic findings from this study was the higher percentage of men with diabetes (24.8% vs 17.3% [$P = .001$]), and a higher percentage of women with hypothyroidism (13.4% vs 5.6% [$P = .001$]) presenting with adhesive capsulitis. Prior studies have shown a higher prevalence of hypothyroidism among women in the general population, with a prevalence of approximately 8% in women compared with just 1% in men, but the percentages of patients with adhesive capsulitis and hypothyroidism far exceeded this for both sexes.^{14,15} With regard to sex differences surrounding response to treatment, this study found that nondiabetic women responded better to isolated PT without a corticosteroid injection than men and that women in general responded better to a single corticosteroid injection than men. The specific mechanisms leading to the sex link of adhesive capsulitis, as well the variations in response to nonoperative treatments between men and women with adhesive capsulitis, are currently unclear and deserve further investigation. It may be that the capsular thickening in women is less intense than in men, that women are more compliant with physical therapy than men, or a different reason. Whatever the reason, women in this

Table 4. Bivariate Analysis for Patients With Adhesive Capsulitis Describing all Patients, as Well as Patients Without Diabetes, and Number of Injections Required for Symptom Resolution

	%Resolved		P Value
	Females (n = 946)	Males (n = 431)	
No Injection (all patients)	79.5%	70.4%	.092
No Injection (nondiabetics only)	80.8%	68.9%	.046
Single Injection (all patients)	96.7%	92.0%	.005
Single Injection (nondiabetics only)	97.1%	94.1%	.050
Multiple Injections (all patients)	89.0%	87.3%	.743
Multiple Injections (nondiabetics only)	86.4%	93.1%	.158

Table 5. Bivariate Analysis of Treatment Options and the Impact of Diabetes on Symptoms Resolution With Corticosteroid Injections

Intervention	% Resolved		P Value
	Diabetics	Nondiabetics	
No Injection	61.7%	83.6%	.001
Single Injection	86.7%	95.9%	.001
2 + Injection	89.3%	88.4%	.599

study had greater success with nonoperative treatment than men.

Although sex is an important factor to consider in patients with adhesive capsulitis, patients with diabetes present a different set of challenges for the treating surgeon. Diabetes has been associated with many orthopaedic conditions secondary to soft tissue thickening and proliferation, including adhesive capsulitis, trigger finger, Dupuytren's, and others.¹⁶ This study found a relatively high percentage of patients with diabetes (20%) among all patients who were diagnosed with adhesive capsulitis. The patients with diabetes in this study also presented with more significant loss of forward flexion compared with the nondiabetic patients (108° vs 114° [$P = .003$]), and those who attempted PT alone without a corticosteroid injection responded less favorably to this than nondiabetic patients. Unfortunately, as predicted, patients with diabetes did not respond as well to intraarticular corticosteroid injections as nondiabetic patients (86.7% vs 95.9% [$P = .001$]). Furthermore, more than one corticosteroid did not improve outcomes in patients with diabetes (nor did it improve outcomes in nondiabetic patients). This is an important finding when counseling patients with diabetes who present with adhesive capsulitis. Although intraarticular corticosteroids still are somewhat effective at resolving symptoms of adhesive capsulitis in patients with diabetes, these injections are not as effective as they are in nondiabetic patients, and repeat corticosteroid injections do not appear to increase the success of nonoperative management.¹³

No patient with diabetes in this study developed a complication after the steroid injection, although each patient was counseled before the injection regarding a rise in blood glucose levels after the injection because prior studies have demonstrated this response in patients with diabetes.¹⁷ A lack of response by patients with diabetes to corticosteroid injections has also been seen with corticosteroid injections for trigger finger.¹⁸ Baumgarten et al (18) performed a prospective, randomized controlled double-blinded study where they evaluated the effectiveness of corticosteroid injections in treating trigger finger. The study included 30 patients with diabetes (35 digits) and 29 nondiabetic patients (29 digits). All of the nondiabetic patients received a corticosteroid injection, whereas 20 digits in the

diabetes group received a corticosteroid injection, and 15 received a placebo injection. The authors found that 86% of digits in the nondiabetic group had a successful outcome compared with 63% in the diabetic corticosteroid group ($P = .03$). This is consistent with the results in our study indicating that patients with diabetes do not respond as favorably to corticosteroid injections as nondiabetic patients. Given the decreased response to conservative treatment, a higher percentage of patients with diabetes in this study required an arthroscopic capsular release with manipulation than nondiabetic patients (13.0% vs 7.3% [$P = .003$]). A separate significant finding was the excellent response of patients with diabetes to operative management, with no significant differences in improvement in postoperative forward flexion or external rotation between patients with diabetes and nondiabetic patients who underwent arthroscopic capsular release and manipulation.

The ideal number of glenohumeral corticosteroid injections for patients with adhesive capsulitis has not been well described.^{8,19} A previous systematic review attempted to report on the benefit of multiple GH injections in patients with adhesive capsulitis.¹⁹ Unfortunately, many of the included studies in this systematic review did not differentiate among one, two, and three injections but rather gave ranges for the number of injections. Hence, the authors concluded that one to three injections was the ideal number because no benefit was seen with higher ranges for numbers of injections. Our study found no additional benefit from multiple corticosteroid injections compared with the first injection in treating adhesive capsulitis. Therefore it appears that physical therapy plus one intraarticular corticosteroid injection is the most effective nonsurgical treatment for patients with adhesive capsulitis. Other treatment options, including hyaluronic acid, have been evaluated and have shown no benefit over corticosteroids.²⁰ Further studies evaluating other treatments such as biologics are necessary to determine whether these treatments afford any significant benefit over corticosteroids and PT and should be incorporated into the adhesive capsulitis treatment algorithm.

Limitations

This study has several limitations. It is a retrospective case series, and, although the number of included patients is high, it suffers from the limitations of a retrospective study. The results are from a single patient population and so may not be generalizable outside of the author's practice. Patient-reported outcome scores were not collected, so satisfaction and clinical outcome scores were unknown. Finally, the type (insulin vs non-insulin dependent) and severity (by hemoglobin A1c) of diabetes were not assessed, so it is unclear whether the diabetic population was normally distributed or

skewed to patients with poorly controlled or well-controlled diabetes. Prior studies have not specifically evaluated this, and it is something we will begin to evaluate moving forward.

Conclusion

In shoulder adhesive capsulitis, women and patients with diabetes are more commonly affected, and patients with diabetes respond less favorably to physical therapy in isolation and physical therapy plus corticosteroid injections than nondiabetic patients. No benefit from multiple intraarticular corticosteroid injections was seen compared with a single intraarticular corticosteroid injection in patients with diabetes and nondiabetic patients. Patients with diabetes and nondiabetic patients functionally improve after capsular release and manipulation if conservative treatment for adhesive capsulitis fails.

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